DOOR UNLOCKING SYSTEM USING FACE MASK

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Abstract: The present pandemic of Covid-19 is causing a health crisis. Wearing a face mask is one of the most efficient ways to combat the illness of virus. However, it is seen that a majority of the population does not wear a mask and there are many who still do not know the proper technique of wearing one. Despite various protocols, it is difficult to manually control a population of billions in a country like India. This paper proposes a face mask detection based door unlocking system that may be used by authorities to mitigate, evaluate, prevent, and prepare action against COVID-19 by ensuring that people follow the basic protocol given by the government. The system also identifies faces which are not properly covered and the model is trained in a way that it detects almost all types of masks that people usually wear. The objective of paper is to build a model focusing on face mask detection that is cost effective and also detects the proper orientation of the mask that is used.

Keywords: Face Mask Detection; Door Unlocking system; Face Mask Door Unlocking System; Face Mask, Covid'19 Prevention; Cascade Classifier

1. INTRODUCTION

Face Mask Door Unlocking System can be used in various public places; it not only detects the person with masks, but also detects the orientation of how it should be worn. This is a unique model designed by keeping the current COVID situation in mind. It will be very helpful, as it gives a clear message to those who aren't following proper guidelines, and it can also reduce the spread of the virus.

The model is trained to scan the person entering any place having a Face Mask Door Unlocking System installed. After the scan results, the door will be unlocked according to the accuracy and the orientation of the mask worn and then the person will be allowed to enter the place. As the model is cost efficient it can be installed in most of the public places and the safety of everyone will not be jeopardized too. This specifically does not require a person to remind everyone to wear the masks

properly. This is where our proposed model comes into light and it also reduces the need to monitor whether a person is wearing a mask or not.

2. LITERATURE REVIEW

Various methodologies and techniques are proposed and many tools are built for either face mask detection or door unlocking system. In this section few methodologies are discussed.

Amritha Nag, Nikhilendra J, Mrutyunjay Kalmath [1] proposed a face recognition system using RaspberryPi with OpenCV. Python programming language was used for programming the system. Face recognition is done in real time from specific images, i.e. saved images.

Suraj Pawar, Vipul Kithani, Sagar Ahuja, Sunita Sahu [2] proposed and demonstrated an optimal smart home security approach with less cost and increased security using IOT and Face Recognition with an android application. The stranger identification gives a warning using an LCD display and sends notification via SMS and email to the homeowner.

Hteik Htar Lwin, Aung Soe Khaing, Hla Myo Tun [3] proposed a system with automatic door access system by using face recognition and detection is done using the Matlab program on PC.

A. R. Syafeeza , M. K. Mohd Fitri Alif , Y. Nur Syifa Athirah, A. S. Jaafar , A. H. Norihan, M. S. Saleha [4] designed a model with face recognition using deep learning techniques and Internet of Things (IoT) was also used to perform efficient door access control systems.

Toshanlal Meenpal, Ashutosh Balakrishnan, Amit Verma [5] proposed Facial Mask Detection using Semantic Segmentation .They were not only able to generate accurate face masks for human objects from RGB channel images containing localized objects and were also able to detect non frontal and multiple faces from single image.

Vinitha.V, Velantina.V [6] proposed Covid-19 Facemask Detection with Deep Learning and Computer Vision using OpenCV, tensor flow, keras, Pytorch and CNN. The detector can detect if the person is wearing a face mask.

Samuel Ady Sanjaya, Suryo Adi Rakhmawan, [7] using MobileNetV2 they proposed Face Mask Detection in the period of COVID-19 Pandemic and by using machine learning techniques. It is able to recognize face masks and determine up to what extent they were being worn. This can be an easy move for authorities to use more unstructured data.

Wenxuan Han,Zitong Huang ,Alifukuerban,Meng Yan ,Haitang Fu [8] proposed A Mask Detection Method for Shoppers Under the Threat of COVID-19 Corona virus using a modified SSD method to detect whether shoppers are wearing masks in the supermarket and also proposed a lightweight backbone network and Feature Enhancement Module (FEM), which improves the overall detection effect of the algorithm.

Anirudh Lodh, Utkarsh Saxena, Ajmal khan, Anand Motwani, Shakkeera L, SharmasthValiV [9] proposed a Prototype which is an integration of Face Mask Detection and Person Identification Model – COVID-19, by combining the person identification along with the face mask detection model, this provides extra security but can only be used in highly authorized places, it can also send the email notifications to people who have registered on their platform who are not wearing a mask.

Md.Sabbir Ejaz, Md. Rabiul Islam [10] proposed a Masked Face Recognition Using Convolutional Neural Network on two data sets using FaceNet model which detects the masked /non masked faces with SVM algorithm by machine learning techniques

By observing and inferring from all the above research papers, we can clearly state that here is no existing model which is focusing on "***Face mask Door unlocking system"***. The existing systems are focusing on developing either most efficient face mask detection / Optimum or cost efficient door unlock system by face recognition. Many of the proposed models of face mask recognition cannot predict all kind of face masks that are being used / that are emerging newly. Ex: Face printed masks. Some of the models cannot detect the mask if the orientation of the mask is changing. Even the door unlock systems are used mainly in the offices / authorized places , they cannot be applicable for public places since models are trained up by storing the data sets of authorized people and are only restricted for office use. So, by considering all the above problems we came up with a solution /idea of **"Face Mask Door unlocking system"** to detect face masks by recognizing all kinds of face masks with different orientations in a cost effective way.

3. PROPOSED SYSTEM AND METHODOLGY

We have built a model which can detect any kind of face mask in any angle, view or orientation which is shown in Figure 3.1. Here we have taken a precaution of having an Automatic door unlocking system using IOT which doesn't require any authorization to unlock the door and allows the people to enter into that particular place only if he /she is wearing a mask**.** It is highly beneficial in public places like Supermarkets, malls, Movie theatres, Parks, Grocery stores etc. We

have used Machine learning techniques for training the machine or model and the build, model schematic /circuitry is based on IOT, which is cost efficient. We have used Thing speak web API to allow Google Colab code and TinkerCAD code to communicate with each other. Each API key has a Read code and Write code. Then we give our Write code to Google Colab, and read the API key to the TinkerCAD**.** Colab will write values to the web API if the facemask is detected and the Tinker CAD code reads the value from the API and either opens the door or not. Tinker CAD circuit read the value of transmitted data and could extract the last 2 digits and can decide to either open the door or not.

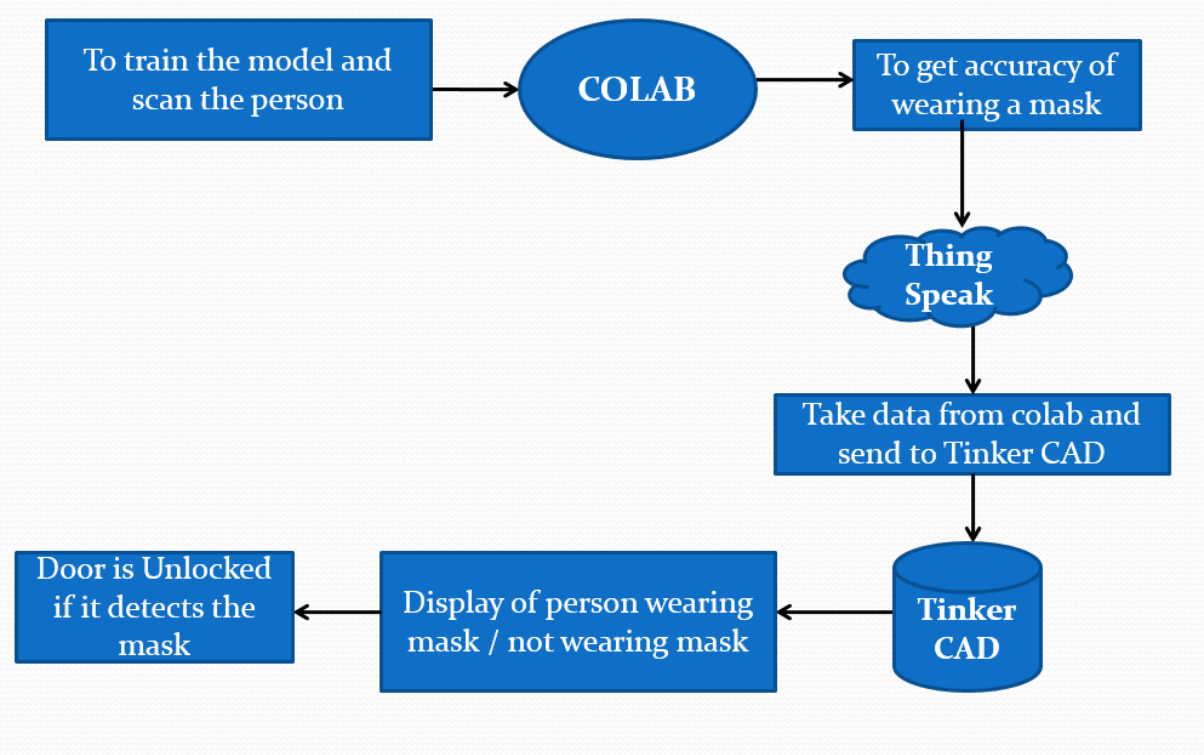


Figure 3.1: Block diagram of proposed Face Mask Door Unlocking system

4. ALGORITHMS

4.1. CASCADE CLASSIFIER:

It is a machine learning based technique in which a cascade classifier is trained using a large number of positive and negative images. It is then used for detecting objects in other images. Here we will work with face mask detection. Initially, the algorithm needs a lot of positive images (images

of faces with mask) and negative images (images without mask) to train the classifier. Then we need to obtain features from it as shown in Figure 4.1

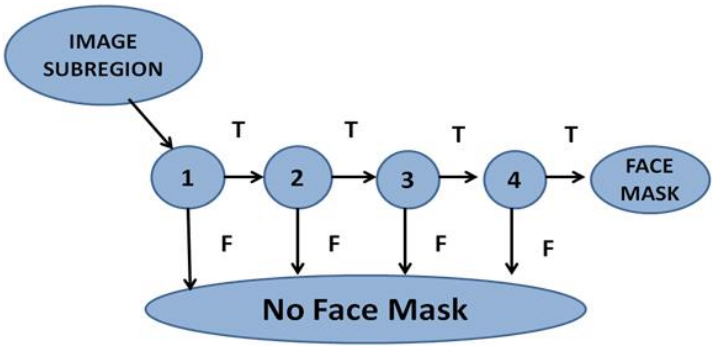


Figure 4.1: Algorithmic structure of cascade classifier

4.1.2. TENSOR FLOW:

TensorFlow is a freely available and it is an open source machine learning software library. It may be used for a wide range of applications, with a focus on deep neural network training and inference. It's a data flow and differentiable programming-based symbolic math library

4.1.3. KERAS:

Keras is an open-source software library for artificial neural networks that provides a Python interface. Keras serves as a TensorFlow library interface. We used the tensorflow.keras.preprocessing. Image tool set and associated libraries for preprocessing and real-time data augmentation on picture data.

4.1.4. CV2:

OpenCV-Python is a Python binding's library aimed at solving computer vision challenges. The imread() method in CV2 loads an image from a given file. This method produces an empty matrix if the picture cannot be read (due to a missing file, insufficient permissions, or an unsupported or invalid format). Using image processing techniques, we convert the RGB images to grayscale, which will be utilized as an input for the cascade classifier (positive and negative Circuit).

4.1.5. OpenCV:

OpenCV is a computer vision library written in Python. OpenCV was created by Intel in 1999, but Willow Garage later took over its support. OpenCV is compatible with a wide range of programming languages, including C++, Python, and Java, among others. Windows, Linux, and MacOS are among the systems that are supported. OpenCV (OpenCL) Python is simply a wrapper

class for the C++ library that is used with Python. All OpenCV array structures are translated to and from NumPy arrays using this method. This makes it easy to connect it with other NumPy-based libraries. Libraries like SciPy and Matplotlib, for example.

5. DATA SET

5.1. Data set containing the images of people not wearing a mask:

This data sets contains 525 .jpg test images as shown in Figure 5.1, which contains people without wearing the masks, which is used to train the model / machine to make it recognize the people who are not wearing masks

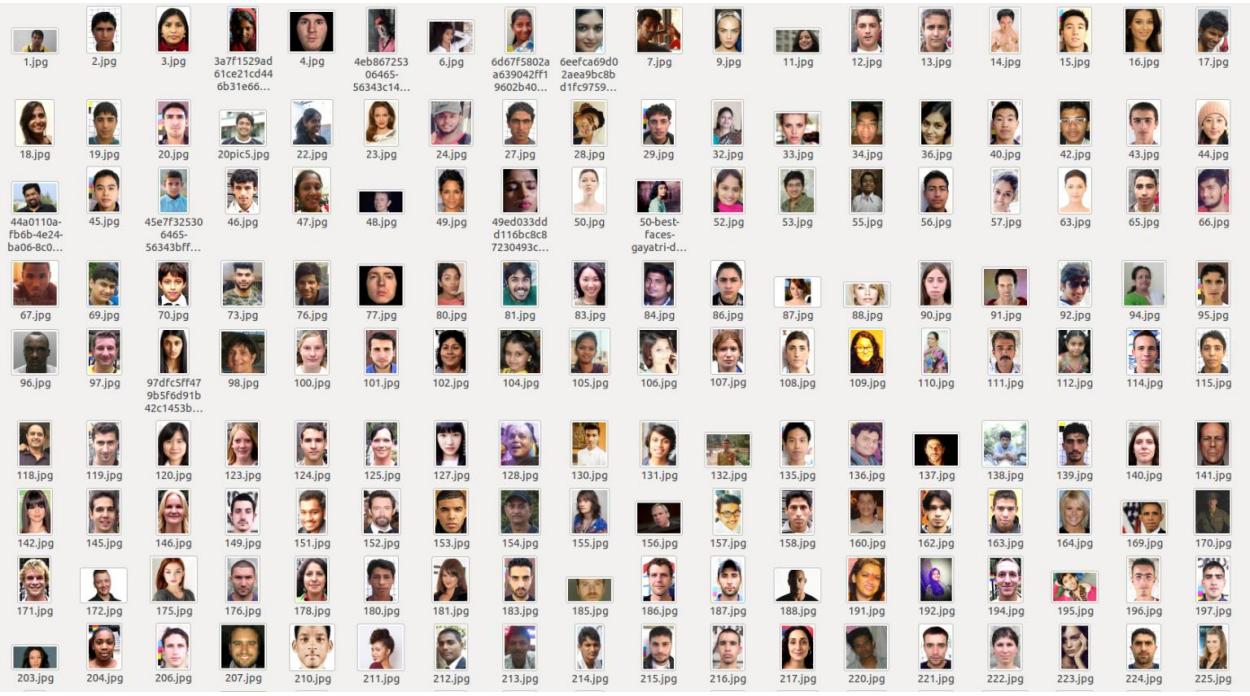


Figure 5.1: Data set containing the people with no mask

5.2. Data set containing the images of people wearing different kinds of masks:

This data set contains 632 .jpg test images as shown in Figure 5.2, which contains people with different kind of masks which helps the machine to recognize the people who are wearing the masks

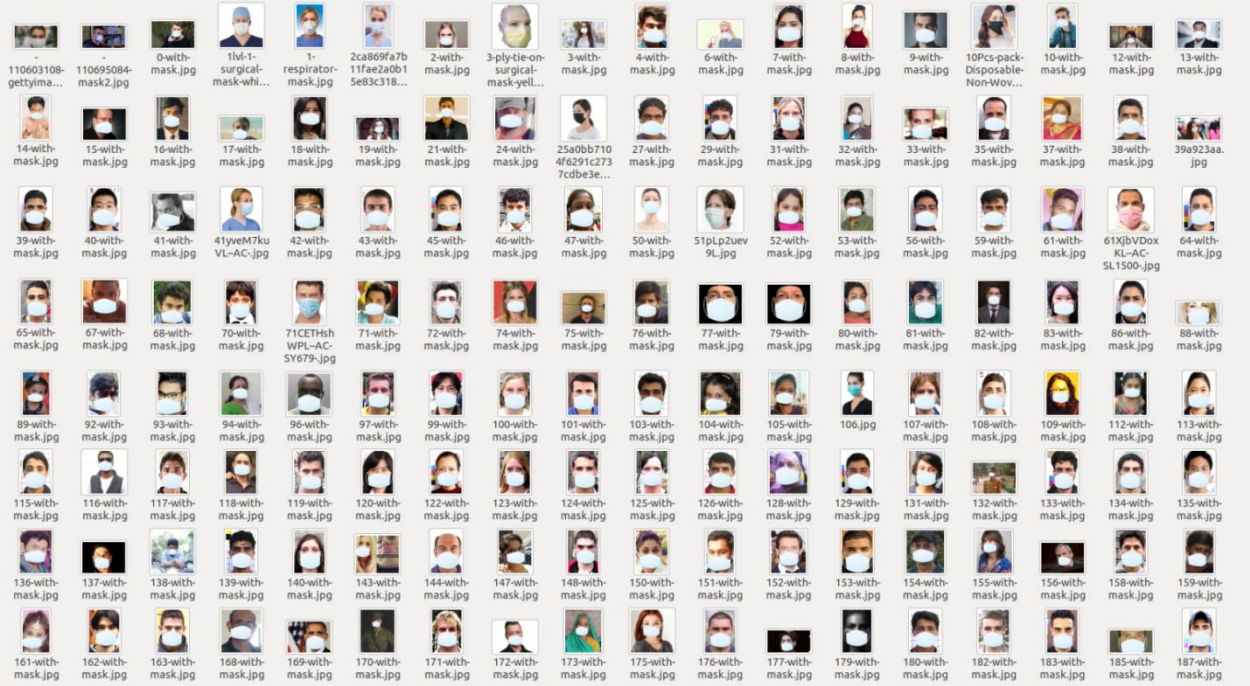


Figure 5.2: Data set containing the people with different kind of masks

6. RESULTS AND DISCUSSION

6.1. Surgical Mask: The person is wearing a mask completely, so the output is shown as mask 100% in Google Colab as shown in Figure 6.1 and in TinkerCad we can see that the door is unlocked as a person is wearing a mask which is shown in Figure 6.2.

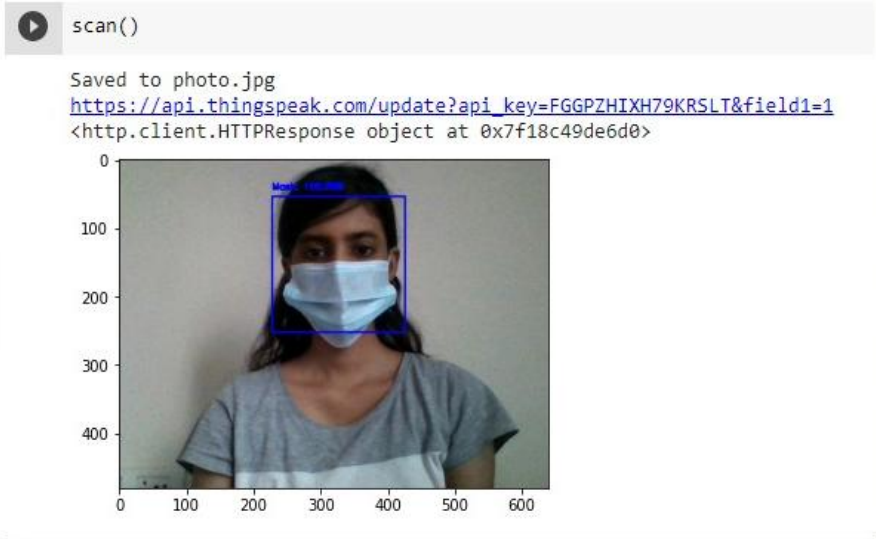


Figure 6.1: Model detecting a person wearing surgical mask

Meanwhile here, in the TinkerCad as the person is wearing the mask it shows mask detected, you can enter IN

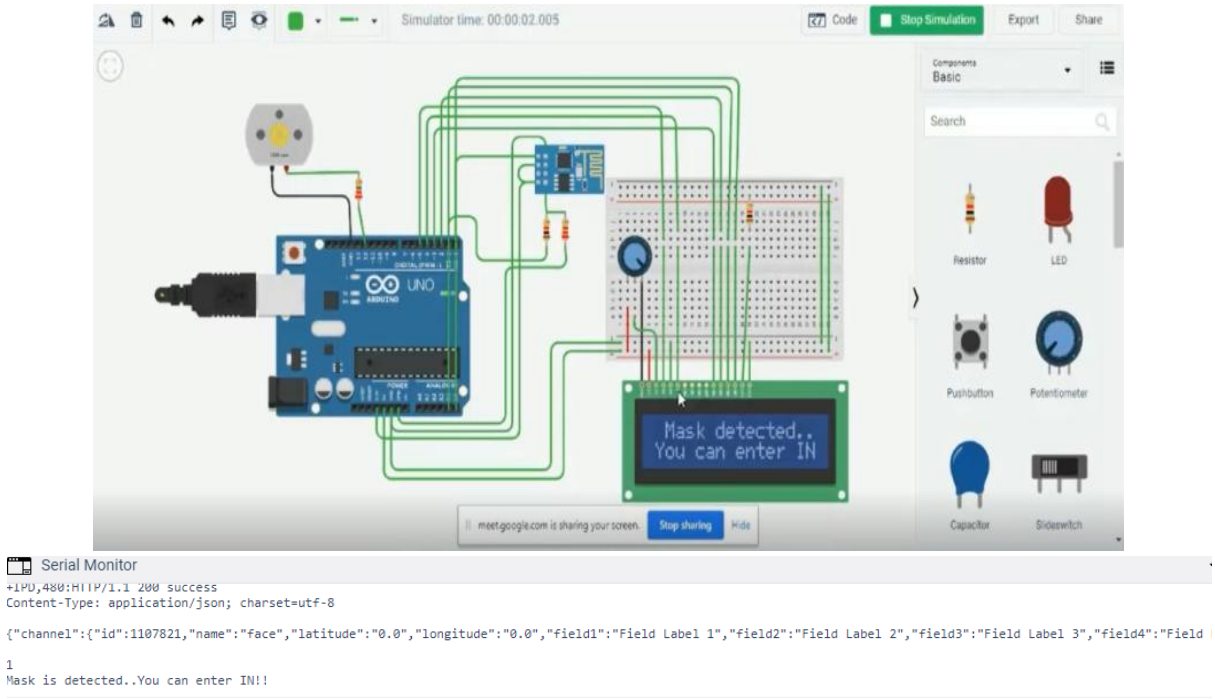


Figure 6.2: TinkerCad output showing "mask detected, you can enter in" message in the LCD of the circuit and serial monitor and the motor also rotates

6.2. Cloth Mask: The person is wearing a different kind of mask which is printed mask, even then the trained model is able to detect the mask and the output is shown as mask 99% in Google Colab as shown in Figure 6.3 and in TinkerCad we can see that the door is unlocked as a person is wearing a mask which is shown in Figure 6.4.

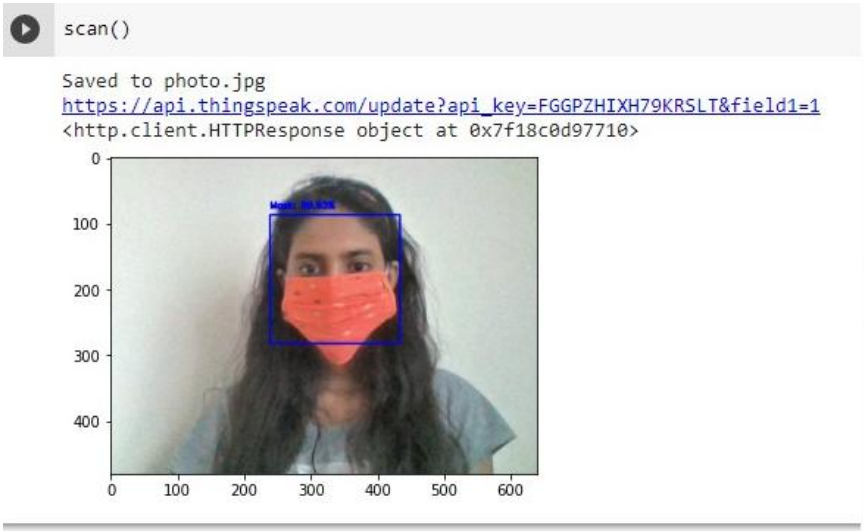


Figure 6.3: Model detecting a person wearing printed cloth mask

In the Tinker Cad as the person is wearing the cloth mask it shows mask detected , you can enter IN

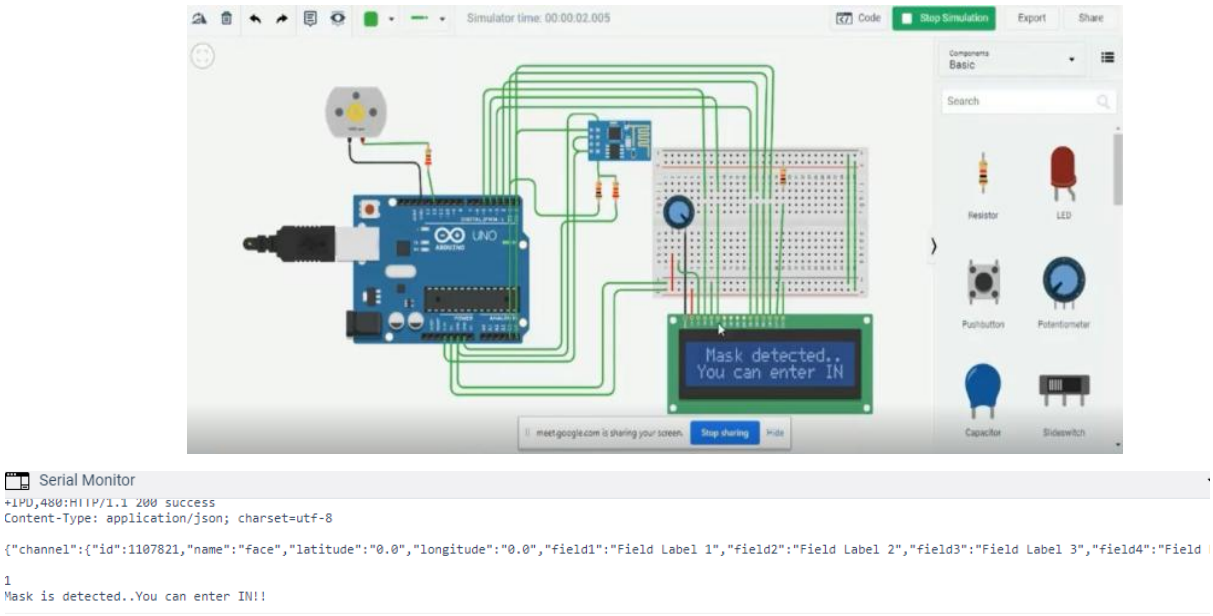


Figure 6.4: TinkerCad output showing "mask detected, you can enter in" message in the LCD of the circuit and serial monitor and the motor also rotates

6.3. With printed cloth mask at different angle:

Here, the person is wearing a different kind of mask which is printed mask in a different angle, even then the trained model is able to detect the mask and the output is shown as mask 100% in Google Colab as shown in Figure 6.5 and in TinkerCad we can see that the door is unlocked as a person is wearing a mask. Mean while here, in the Tinker Cad even the orientation of wearing the mask is changed it is still able to adapt it and as the person is wearing the mask it shows **mask detected, you can enter IN** which is shown in Figure 6.6.

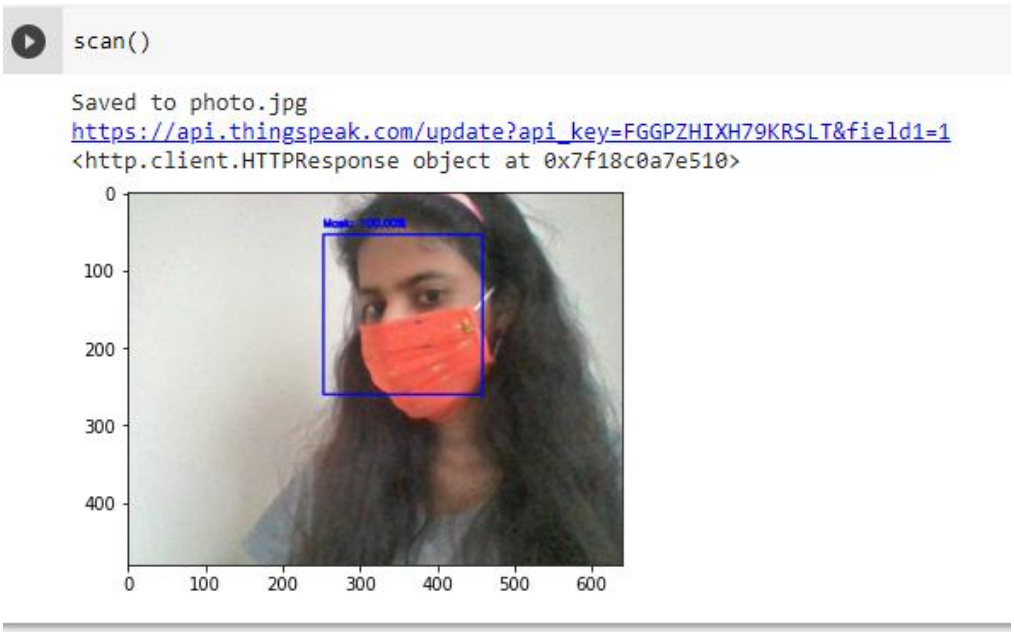


Figure 6.5: Model detecting a person wearing printed cloth mask in different orientation

In the TinkerCad as the person is wearing the cloth mask it shows mask detected, you can enter IN

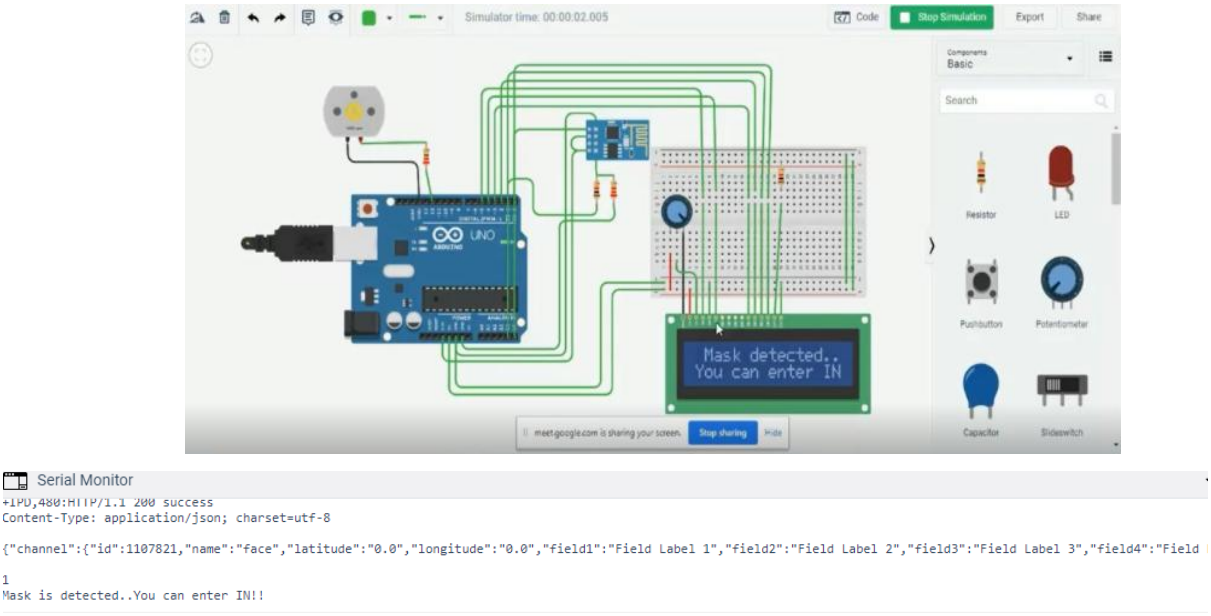


Figure 6.6: TinkerCad output showing "mask detected, you can enter in" message in the LCD of the circuit and serial monitor and the motor also rotates

6.4. N95 Mask: The person is wearing a N95 Mask properly, the output is shown as mask 100% in Google Colab as shown in Figure 6.7 and in TinkerCad we can see that the door is unlocked as a person is wearing a mask.

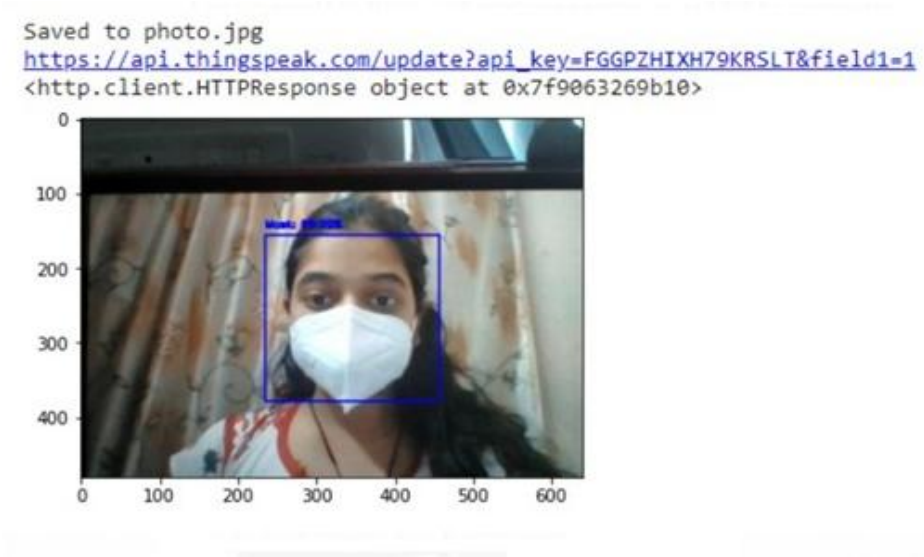


Figure 6.7: Model detecting a person wearing N95 mask

Meanwhile, in the TinkerCad as the person is wearing the N95 mask properly it shows **mask detected, you can enter IN** as shown in Figure 6.8

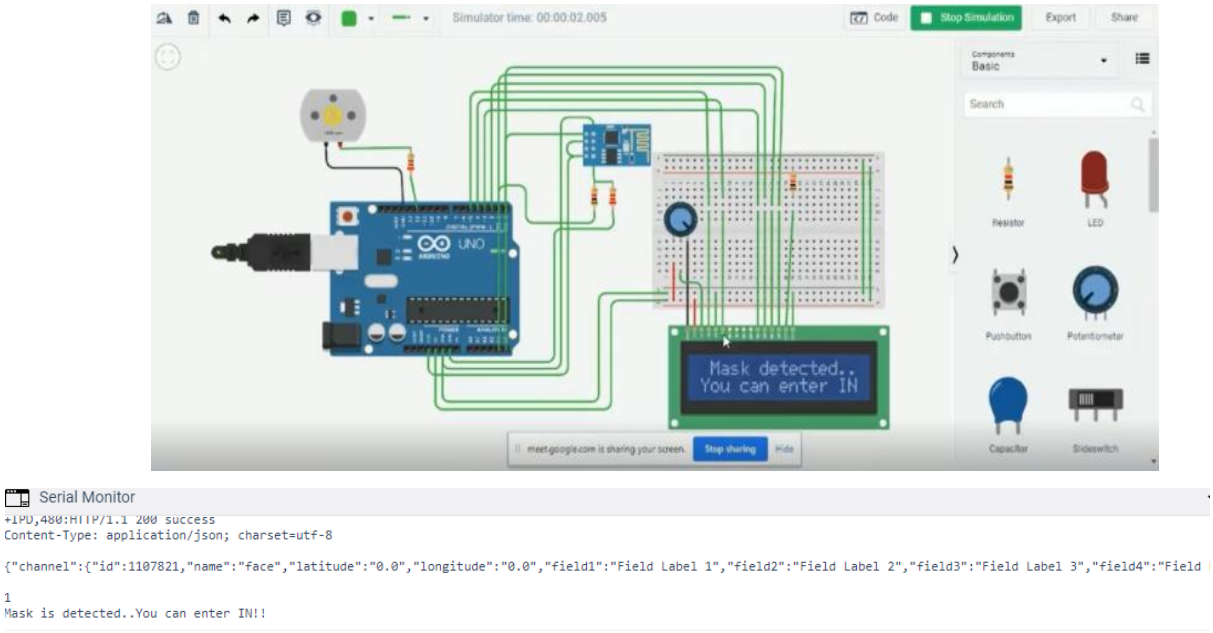


Figure 6.8: TinkerCad output showing "mask detected, you can enter in" message in the LCD of the circuit and serial monitor and the motor also rotates

6.5. Face mask with Face Shield: Here, the person is wearing a Mask along with face shield, the output is shown as mask 100% in Google Colab as shown in Figure 6.9 and in TinkerCad we can see that the door is unlocked as a person is wearing a mask.

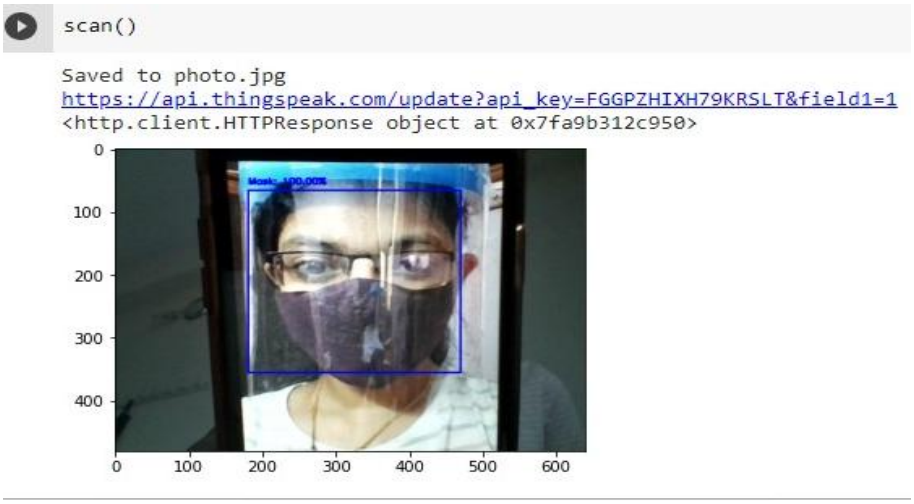


Figure 6.9 : Model detecting a person wearing Face Shield with face mask

In the Tinker Cad as the person is wearing the face mask along with a face shield it shows a **mask detected, you can enter IN** as shown in Figure 6.10

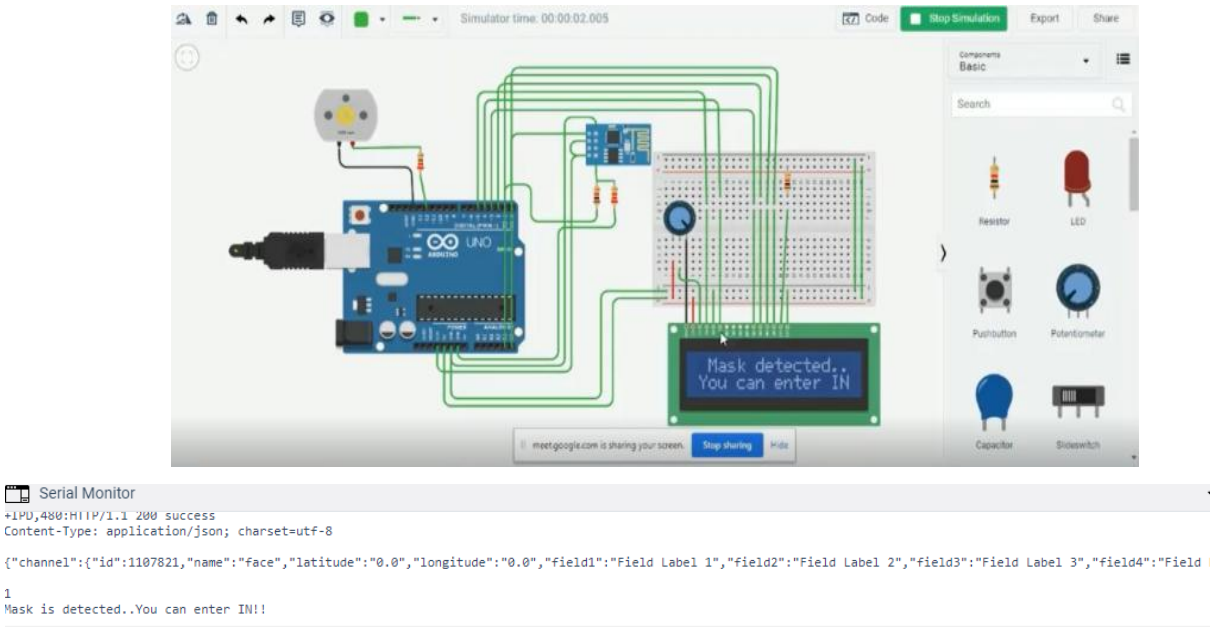


Figure 6.10: TinkerCad output showing "mask detected, you can enter in" message in the LCD of the circuit and serial monitor and the motor also rotates

6.6. Bandana/Neck Gaiter

The person is wearing a Bandana, the output is shown as mask 100% in Google Colab as shown in Figure 6.11 and in TinkerCad we can see that the door is unlocked as a person is wearing a Bandana/Neck gaiter.

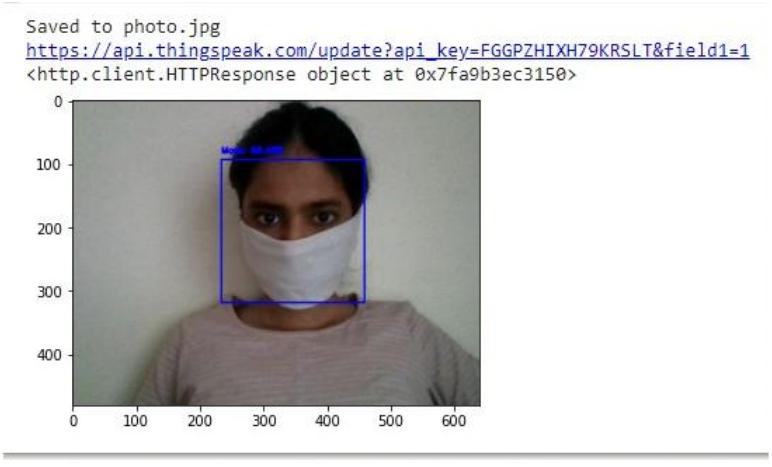
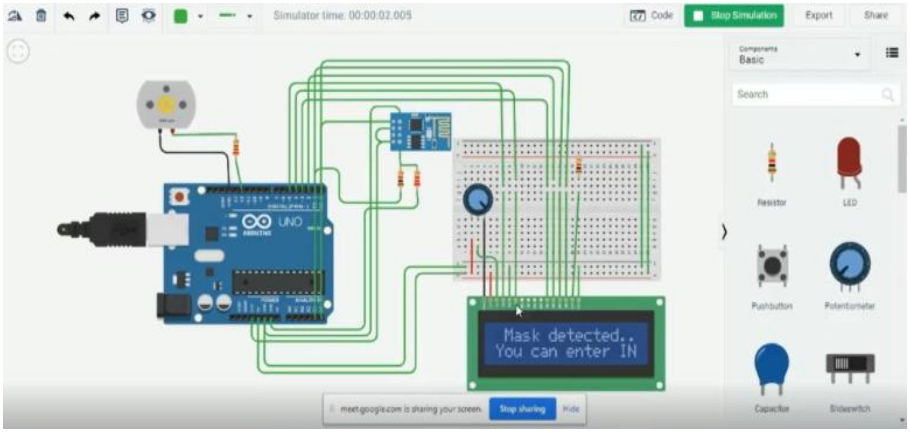


Figure 6.11: Model detecting a person wearing bandana/balaclavas

In the Tinker Cad as the person is wearing the Bandana properly it shows **mask detected, you can enter IN** as shown in Figure 6.12



Serial Monitor

```
+IPD,480:HTTP/1.1 200 success
Content-Type: application/json; charset=utf-8

{"channel":{"id":1107821,"name":"face","latitude":"0.0","longitude":"0.0","field1":"Field Label 1","field2":"Field Label 2","field3":"Field Label 3","field4":"Field

1
Mask is detected..You can enter IN!!
```

Figure 6.12: TinkerCad output showing "mask detected, you can enter in" message in the LCD of the circuit and serial monitor and the motor also rotates

6.7. No Mask: Here, the person is not at all wearing the mask, so the output is shown as No mask 100% in Google Colab as shown in Figure 6.13 and in TinkerCad we can see that the door is not unlocked as a person is not at all wearing the mask.

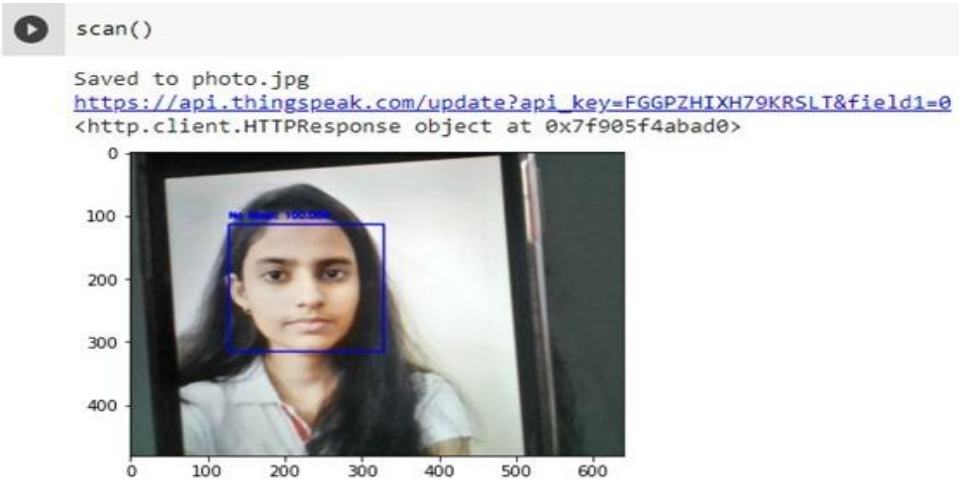


Figure 6.13: Model detecting a person who is not wearing a mask

Meanwhile, in the TinkerCad we can see the output as **No mask Please wear Mask** as shown in Figure 6.14, because the person is not at all wearing the mask.

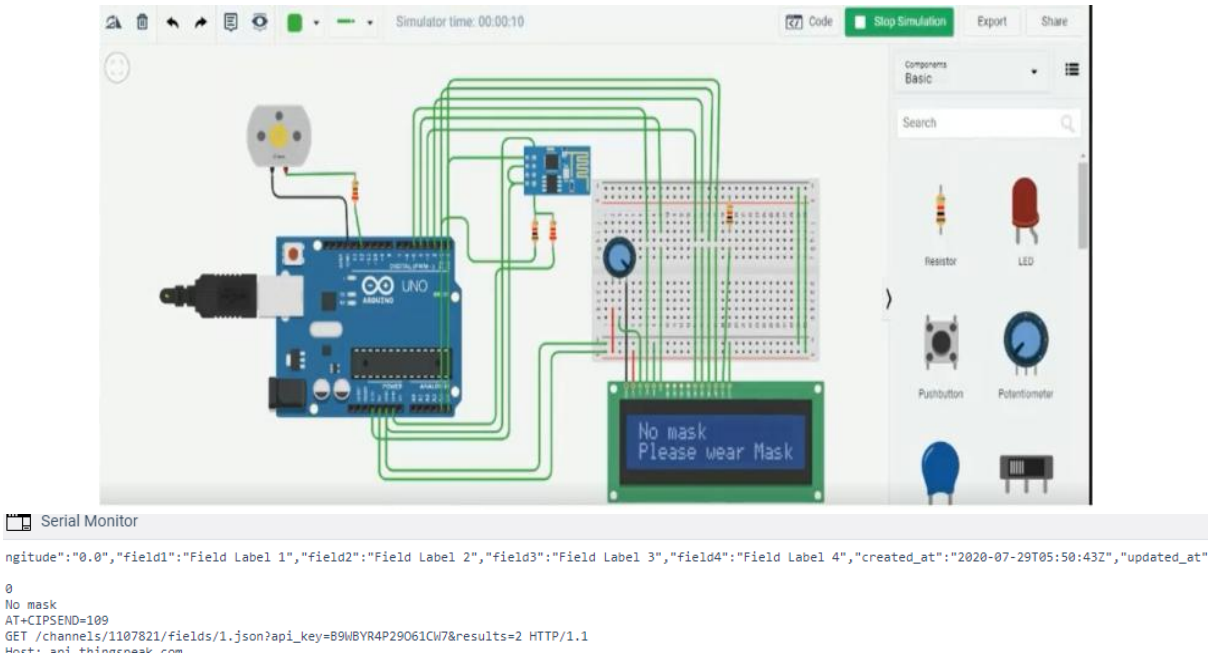


Figure 6.14: TinkerCad output showing No mask detected , please wear mask in LCD and serial monitor

6.8. Half Mask On

The person is not wearing the mask properly, so the output is shown as No mask 97% in Google Colab as shown in Figure 6.15 and in TinkerCad we can see that the door is not unlocked as a person is not wearing a mask properly

Figure 6.15: Model detecting a person who is not wearing a mask properly

In the TinkerCad, we can see the output as **No mask Please wear Mask** as shown in Figure 6.16, because the person is not wearing the mask properly.

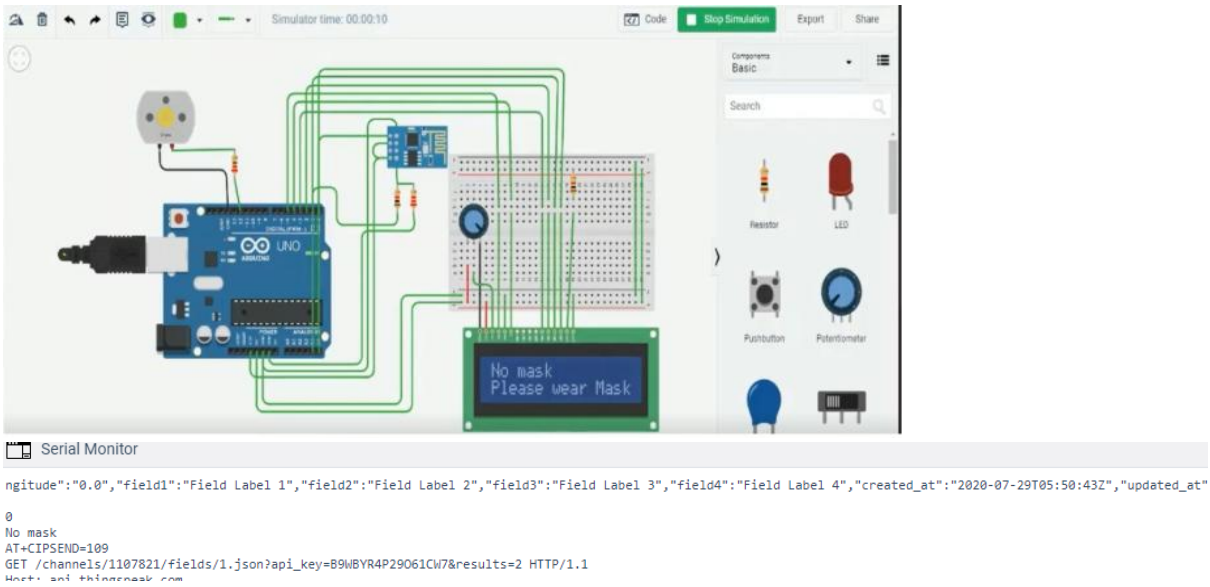


Figure 6.16: TinkerCad output showing No mask detected , please wear mask in LCD and serial monitor

7. CONCLUSION AND FUTURE SCOPE

The world is still struggling to recover from this COVID'19 dreadful disease. There is still a lot which we have to learn about this new sickness. Even though people are getting vaccinated now, it might still take a lot of time for reaching to the normal state safely. Until that time, wearing masks has been shown to help stop the spread of COVID-19. While most of the people neglect this guideline of wearing mask and roam around the public places. Even at the entrances of the supermarkets, malls, and theatres etc. the security people are not concerned of stopping most of the people who aren't wearing the masks, which leads to the spread of this dreadful disease. As we're headed for a faceless future as masks become the new normal.

Hence, this proposed system helps in many ways to monitor if people are following the appropriate COVID protocols. If it is placed in the entrance of any of these public places, it can be able to detect the people who are not wearing masks and the door doesn't open and stops that person to enter into that place, until someone who is wearing a mask comes, which indeed stops the spread of COVID'19. In future, we aim to extend the project by integrating with a system that can detect the person's identity which can be a wholesome model. Another future scope is that it can be used in CCTV cameras for capturing a large number of people.

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